

## Appendix C

### ***DRAFT 4-24-06***

#### **Proposed Method to Improve Temporal Distribution Of Gridded On-road Motor Vehicle Emissions**

##### Background

This document discusses a proposed method to improve the temporal resolution of gridded on-road motor vehicle emission inventories. The Integrated Transportation Network (ITN) and the Direct Travel Impact Model (DTIM) are currently used to develop the hourly, spatial distribution of on-road emissions. The ITN is a seamless on-road transportation network for California that contains about 250,000 roadway segments (or 'links'). A revision to the ITN, called ITNv2, has recently been completed. The ITNv2, like the original ITN, is developed from the transportation networks of several regional transportation planning agencies (RTPAs) as well as the California Department of Transportation's (Caltrans) statewide model. The hourly emission maps produced from the ITNv2 and DTIM are used as spatial surrogates to map the county emission estimates produced from ARB's on-road motor vehicle emission model, EMFAC.

Travel activity data used in the ITNv2 represent travel during the core weekdays, Tuesday, Wednesday and Thursday. We do not propose to make adjustments to the hourly emissions of light or medium duty vehicles produced by ITNv2/DTIM/EMFAC for these core days. However, (except for southern California) hourly distributions of heavy-duty vehicles are made by ratios of light duty travel. Therefore, we propose to use count data, which is distinguished by the vehicle type and number of axles, to temporally redistribute heavy-duty vehicle activity for all days, and light and medium duty vehicles for all non-core days. We place a special emphasis on weekend days since many pollutant episodes contain one or more weekend days.

In previous modeling work for CCOS using the first version of the ITN, adjustment factors were applied to approximate travel on weekend days by lowering the volume on weekend days. This adjustment was based on a traffic study conducted by UC Davis for CCOS. See the description of the previous methodology at the end of this document. Heavy duty NO<sub>x</sub> emissions were further reduced to reflect lowered weekend truck travel. However, all vehicle types were assigned the same diurnal patterns. This is of concern because trucks are known to have different diurnal distributions than cars and they have high NO<sub>x</sub> emissions.

Due to this concern, the Weekend Truck Subcommittee of the northern California SIP Gridded Inventory Coordination Group (GICG) was formed to investigate a way to improve day-of-week adjustments, for vehicle types as needed, but

particularly for heavy-duty trucks. Participants in the subcommittee are members of the GICG with particular knowledge and/or interest in improving the adjustment factors and include representatives from Caltrans, ARB, Bay Area AQMD, San Joaquin Valley Unified APCD and Alpine Geophysics (the developer of the ITN). Since Caltrans count data are available to improve the temporal distribution of emissions by vehicle type, the UC Davis adjustments will not be used in the ITNv2.

As a note of interest, while we are proposing ways of improving the temporal distribution of emissions, the spatial distribution is only altered at the county level. One way to correct the spatial distribution of on-road motor vehicle emissions on weekend days is through the development of a weekend travel demand model. Some states have begun to investigate the development of a weekend travel demand model; we are unaware of any such pursuit in California largely due to high cost of developing a weekend model.

### Description of Current Work

Leonard Seitz of Caltrans acquired Automatic Vehicle Classifier (AVC) count data from Joe Avis in Caltrans Traffic Ops from many (~139) sites in the state for calendar year 2004 (see Figure 1). Caltrans staff prepared hourly day of week factors for (1) passenger cars (LD), (2) light and medium duty trucks (LM), and (3) heavy-heavy duty trucks (HHDT). Caltrans count data are separated using the Federal Highway Administration (FHWA) vehicle classification scheme (see Table 1). Passenger cars are defined as FHWA classes 1 through 3. Light and medium heavy duty trucks are defined as FHWA classes 7 and 8. Heavy-heavy duty trucks are defined as FHWA classes 9 through 14. Separate factors were prepared for each Caltrans District. One or more counties may fall into a single District. All counties within each Caltrans district will receive the same adjustment. Figure 2 shows a map of county and Caltrans district. Only counts during the summer of 2004 were used, specifically the months of June, July and August excluding data from July 2-5 to remove unusual traffic patterns around the July 4<sup>th</sup> holiday.

### Proposed Method

Temporal on-road activity adjustments by county will be made for:

1. Heavy duty vehicles – all days
2. Light duty vehicles – Friday, Saturday, Sunday, Monday

Daily total activity (daily VMT) adjustments will be made for all vehicle types for Friday, Saturday, Sunday, and Monday. Tuesday, Wednesday and Thursday are considered as one day. Adjustments applied to heavy-duty vehicles on Tuesdays, Wednesdays and Thursdays will be the same for each of the three days.

Since it is EMFAC emission estimates that are being adjusted to derive the final on-road inventory, the relation between EMFAC vehicle classes and Caltrans' adjustment factors is shown here.

<u>EMFAC Class</u>	<u>Description</u>	<u>Caltrans' Factor</u>
1	LDA	LD
2	LDT1	LD
3	LDT2	LD
4	MDV	LD
5	LHDT1	LM
6	LHDT2	LM
7	MHDT	LM
8	HHDT	HHDT
9	Other Bus	No data in ITNv2
10	School Bus	Unadjusted on weekdays, zero on weekend days
11	Urban Bus	LD
12	Motorhomes	LD
13	Motorcycles	LD

where LD based on count data for Fhwa classes 1 through 3

LM based on count data for Fhwa classes 7 and 8

HHDT based on count data for Fhwa classes 9 through 14

Here are the proposed steps for the adjustments:

- 1) Sum the hourly volumes by vehicle type and county on the ITNv2 network.
- 2) For heavy-duty core days there will be an hourly redistribution but no daily VMT adjustment. Light duty vehicle emissions from EMFAC will not be adjusted at all for core days.
- 3) For Friday, Saturday, Sunday, and Monday, develop a set of ratios of Caltrans daily VMT to core days. That is, for Saturday to Tues-Thurs (etc), by Caltrans 3 factor types LD, LM and HHDT.
- 4) Apply Caltrans daily factors by county, and secondly, apply Caltrans' new hourly distributions by county to ITNv2 link activity.
- 5) Run DTIM with revised ITNv2 activity.
- 6) Run EMFAC with day specific temperatures.

- 7) Adjust DTIM output emissions to EMFAC weekday by county.
- 8) For Friday, Saturday, Sunday, and Monday, apply daily ratios from step 3 to hourly DTIM emissions by county.

To summarize, for core days light- and medium-duty vehicle emissions will equal EMFAC emissions by county and hour. For core days, heavy-duty emissions will equal EMFAC but have Caltrans hourly distribution.

For Friday through Monday, EMFAC weekday emissions will be scaled to reflect Caltrans day of week factors.





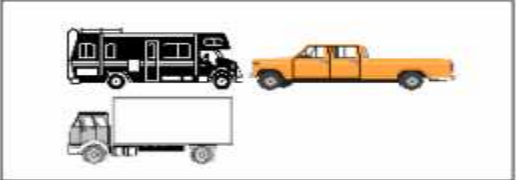

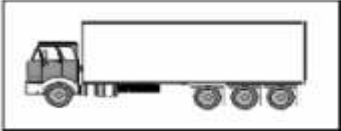
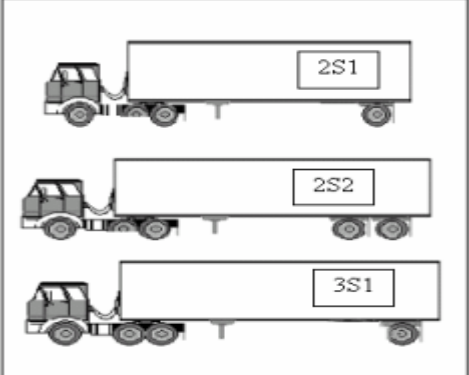
#### Previous Method for Making Weekend Adjustments

EMFAC does not make weekend day estimates, so EMFAC daily emissions were scaled to represent weekend estimates based upon available traffic count data. The ITN version 1 network has activity estimates for a weekend day. In order to approximate an EMFAC weekend day inventory, ARB staff scaled each county's EMFAC pollutants, except NO<sub>x</sub>, by the ratio of ITN VMT for a weekend day divided by the ITN VMT for a weekday for each county. The VMT for a weekend day was determined based on vehicle counts gathered and analyzed by Dr. Deb Neimeier of UC Davis. The county-specific ratio was applied to all vehicle classes and pollutants, except for NO<sub>x</sub> emissions from heavy-duty diesel trucks. Since heavy-duty diesel VMT is drastically reduced on weekends and NO<sub>x</sub> emissions from heavy-duty trucks are large, ARB staff multiplied the weekday NO<sub>x</sub> emissions by a factor of 0.536 (reduction of 46.4%) to estimate the NO<sub>x</sub> emissions on a weekend day. The factor of 0.536 represents the average reduction in NO<sub>x</sub> for a weekend day in the South Coast Air Basin. This NO<sub>x</sub> reduction was derived from Caltrans Weigh-in-Motion traffic counts that can differentiate between vehicle types by weight.

Figure 1 Caltrans Weigh-In-Motion Data Sites



Table 1 Federal Highway Administration (FHWA) Vehicle Classification

Graphic Depiction	FHWA Class	Description
	1	Motorcycles
	2	Passenger Cars (With 1- or 2-Axle Trailers)
	3	2 Axles, 4-Tire Single Units, Pickup or Van (With 1- or 2-Axle Trailers)
	4	Buses
	5	2D - 2 Axles, 6-Tire Single Units (Includes Handicapped-Equipped Bus and Mini School Bus)
	6	3 Axles, Single Unit
	7	4 or More Axles, Single Unit
	8	3 to 4 Axles, Single Trailer


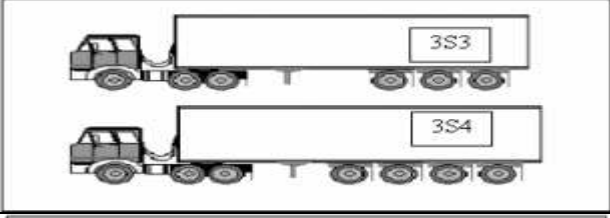

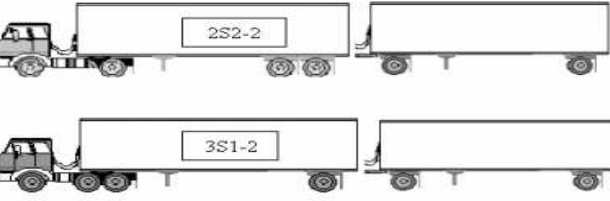

Graphic Depiction	FHWA Class	Description
	9	5 Axles, Single Trailer
	10	6 or More Axles, Single Trailer
	11	5 or Less Axles, Multi-Trailers
	12	6 Axles, Multi-Trailers
	13	7 Axles, Multi-Trailers
No graphic available	14	5 Axles: 3 axle tractor pulling a 2 axle trailer (FHWA considers this type of truck a class 9; Caltrans counts these trucks separately for operational purposes.)

Figure 2 Caltrans District and County Boundaries

